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SCIENCE

# Survival of the richest, not the fittest

A British economist is causing controversy with his new interpretation of what triggered the Industrial Revolution. Roger Highfield reports

The Industrial Revolution saw the rise of steam power and mass production, with cotton mills, potteries, foundries and steel works sprouting up all over England's green and pleasant land. The seismic effects spread from Britain at the end of the 18th century and rippled across the world. It marked a major turning point in history that was as significant as the invention of farming in around 6000 BC.

This period is seen by historians as the point at which modern society was born. From the bucolic stories of rural villages told by Jane Austen in the 1810s to Charles Dickens's depiction of urban poverty in Victorian Britain, classic literature gives a vivid picture of the revolution's impact.

But scholars still argue about when the revolution really started, when its impact was first felt and whether it was too gradual to count as a sudden overthrowing of all that had been before. The most elusive element of all, though, is what triggered it in the first place. Now, that last part of the puzzle may have been solved by a British economist. Next week he will tell the World Bank that it was a change in the cultural – perhaps even genetic – make-up of society that paved the way for the machine age.

In *A Farewell to Alms*, published this month, Glaswegian Professor Gregory Clark of the University of California, Davis, argues that the revolution was not industrial at all. Its roots did not lie in the technologies of Arkwright and Watt but in profound changes that had taken place in society over hundreds of years.

The problem facing all early societies lay in what Clark calls the "Malthusian trap", in honour of Thomas Malthus (1766-1834), who showed that living standards in pre-industrial societies would always be driven back down to a subsistence minimum by population growth, as long as technological advance was slow. In pre-industrial societies women typically had five children. If living standards were good, most of those children survived to adulthood and rapid population growth followed. But with limited resources, only two of those five children survived to adulthood and the population remained stable.

Prof Clark explains that advances in the pre-industrial world, such as innovations in agriculture that boosted crop yields, did allow for a larger population to be supported (world population grew from perhaps 100,000 in 100,000 BC to 770 million by 1800) but as long as society was in the Malthusian trap, these innovations could not allow living standards to rise in the long term. The average person in 1800 was no better off in material terms than in 100,000 BC.

In all pre-industrial societies in the Malthusian trap, some types of people were more successful at survival and passing on their genes, as Charles Darwin argued. In the case of hunter-gatherer and "shifting cultivation" societies such as the Yanomamo of the Amazon basin, alpha males who killed the highest number people tended to sire the most children. But in settled agrarian societies, with law and order, reproductive success shifted from the violent to the prosperous.

We can see this in feudal England, where the successful reproduction of the



richest, not strongest, dates back to the Middle Ages. Records show, says Prof Clark, that "unusually in England, this selection for men was based on economic success from at least 1250, not success in violence".

Later, around 1600, we can use an unusual source – the wills of 2,000 Englishmen, from squires to shepherds – to figure out even more exactly how reproductive and economic success were linked. These wills reveal how rich men were at death and also how many surviving children they had.

Prof Clark concluded that wealth, not social status or literacy, was the best predictor of the number of surviving children. Overall, the rich were leaving twice as many children as the poor. Survival of the fittest here meant survival of the richest.

He argued that this meant downward social mobility, as the poor failed to reproduce themselves and the rich produced surplus children who were then forced to take over the occupations of the poor. The more abundant children of the rich had to slide down the social hierarchy to find work, bringing with them bourgeois values. Consequently, today's population is largely descended

from the economic upper classes of the Middle Ages.

The downwardly mobile had a radically different outlook from the poor, who were more attuned to the outlook of the early agriculturalists, whom Prof Clark regards not as noble savages but "impulsive, violent, innumerate, illiterate and lazy".

The spread of the progeny of the wealthy introduced characteristics such as hard work, patience and peacefulness. The rise in the preference for saving money over the instant consumption of it was mirrored by a steady decline in interest rates from 1200 to 1800. We see in England, from at least the Middle Ages, that the people who succeeded in the economic system – who accumulated wealth, got skills, became literate – were increasing their representation in each generation. This was an ideal society to exploit the introduction of industrialisation.

As well as passing on these cultural traits, Prof Clark thinks the genes linked with them began to spread, meaning that in biological terms, people were better mentally equipped to learn about and accept mechanisation. This resulted in a more organised society and more efficient methods of production. So, in the centuries leading up to the Industrial Revolution, man was genetically adapting to the modern world. This may seem a short time for DNA make-up to change, but, in support of his thesis, Clark points out that a Siberian effort to domesticate foxes paid off in just 30 generations. Honing traits such as patience can be remarkably rapid, he claims. "The triumph of capitalism in the modern world may thus lie as much in our genes as in ideology or rationality."

Why did the Industrial Revolution start in England and not in the much larger populations of China or Japan? Because their elite classes, the Samurai in Japan and the Qing dynasty in China, had surprisingly few children, Clark argues. Thus they would have failed to generate the downward social mobility that lit the touchpaper of the Industrial Revolution

**Cultural forces: the changes wrought by the Industrial Revolution are seen by contrasting the novels of Jane Austen (*Pride and Prejudice*, left) and Charles Dickens**

in Britain. He adds that early English society was also surprisingly stable. "In most English villages, nothing happened from 1200 to 1800." This encouraged the survival of the richest, not the fiercest. His conclusion is provocative because it revives the old notion that changes in people's behaviour drive events, rather than changes in institutions. Indeed, it may get Prof Clark into trouble, given the implication that

other societies are less "evolved". But he makes a sobering point. In one crucial sense we have changed little: despite material affluence, longer life spans and less inequality, we are no happier than our hunter-gatherer ancestors.

● To discover conclusively whether "survival of the richest" laid the foundations of the Industrial Revolution, Prof Clark is conducting a larger follow-up study. For this, he needs to identify 1,000 pairs of fathers and sons who both left wills in England at any time between 1450 and 1914. Readers who know of such pairs are invited to contact Prof Gregory Clark, Department of Economics, University of California, Davis, CA 95616, USA or email gclark@ucdavis.edu.

● *'A Farewell to Alms'* by Gregory Clark (University Presses of California, Columbia and Princeton) is available for £15.95 + £1.25 p&p. To order please call Telegraph Books on 0870 428 4112 or visit [www.books.telegraph.co.uk](http://www.books.telegraph.co.uk).

## A FEAST FIT FOR WARRIORS

Diet is one way to reveal how a person in 1800s England was no better off in material terms than in 100,000 BC. Around 1800, an English agricultural labourer had limited access to the new treats of sugar and tea, and instead faced the "monotony of bread, leavened by modest amounts of beef, mutton, cheese and beer".

In contrast, the warlike Yanomamo dined on "monkey, wild pig, tapir, armadillos, anteaters, alligators, jaguar, deer, rodents, a variety of birds, many insects, caterpillars, various fish, larvae, freshwater crabs, snakes, toads, frogs, various palm fruits, palm hearts, hardwood fruits, brazil nuts, tubers, mushrooms, plantains, manioc, maize, bananas, and honey". For a treat, Yanomamo men were daily consumers of tobacco and a hallucinogenic snuff.

## VIEWFROMTHELAB

Animal evolution does not always give us pointers about ourselves, says Prof Steve Jones



Elsewhere on this page we learn that modern society began with a shift in sexual habits: that over the past few centuries affluent people left more descendants than the poor, so that their genes – and their way of life – took over. The triumph of the rich and relaxed over the fierce and filthy led to a biological change, a national domestication that gave us today's enterprise culture. As Professor Gregory Clark points out, *Homo sapiens* tamed the silver fox in just 30 generations by breeding from the most co-operative: why should he himself not have evolved at the same speed and for the same reason?

It's a diverting idea, but there are plenty of alternatives. It reminds me of the claim that girls prefer pink and boys blue because wives once picked berries while husbands brought home the bacon. My own idea is that Mrs Ice Age glowed by the fire while her mate became blue with cold while hunting mammoths. Each explanation is plausible and each makes excellent food for speculation in the faculties of arts or economics but is no use to us in science without data to test it.

The foxes, though, say remarkable things about domestication. In the 1950s,

Russian scientists began to breed from farmed animals which were most ready to accept humans. Within a few generations, the creatures became calmer and friendlier. They wagged their tails and learnt to bark. Even their looks shifted, with piebald coats, curly hair and floppy ears. They were no longer restricted to sex in the spring. Animals selected in the opposite direction – vulpine equivalents of the underclass – soon became savage.

The parallels with humans are not as close as economists might like. The famous foxes were already a long way from the wild for they had been bred to cope with fur farms when the experiment began. Only one male in 30, and one female in 10, was allowed to breed (for us, that would sanction sex only for men with an annual income of more than £75,000, which excludes

all academics and even some economists). Most important, the animals showed inherited internal changes that simply do not apply to ourselves.

The transformed foxes are pups that never grew up. The breeders were chosen for lack of fear. Over the generations, that led to a drop in sex hormones and an increase in the nerve-transmitter serotonin. For humans, a shortage of that stuff is associated with aggression, depression, anxiety and worse.

The genes involved in the new behaviour have not yet been tracked down (although a new map of fox DNA could change that). But geneticists have uncovered lots of other changes in all the caged animals compared to their wild ancestors. The activity of thousands of brain genes has altered in domestic compared to wild animals, but there were almost no differences in such genes between the serene and ferocious subjects.

That proves most farmed fox evolution happened long before the Russian study. The difficulty was to become even slightly domestic in the first place. That crucial event happened on Prince Edward Island in Canada in the 19th century and it took years before the first captured foxes would reproduce. Once that

behavioural Rubicon was crossed the rest of the agenda followed. The same applies to pigs, cattle, and more: ancient domestications, followed later by selective breeding of our newly amenable friends for meat, milk, or wool.

Men and women, the most domestic of apes, do not fear their fellows but cooperate with them. Any biological shift tied to civilisation probably happened, not during the Industrial Revolution, but with the first modern humans, 100,000 years and more ago.

Like furry beasts, we do inherit individual differences in behaviour, in part because of inborn variation in how much of the serotonin tranquilliser we each make. That matters because it affects how people with depressive illness respond to particular drugs. The poor and struggling may be sadder than the rich and placid, and their hormones may alter to match, but the drug response (and the gene behind it) has no fit with social position. For us, class drives chemicals, not the other way round. On the other hand, there must be some scientific explanation for the society that invented *Big Brother*.

● Steve Jones is professor of genetics at University College London

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‘Like beasts, we inherit behavioural differences’